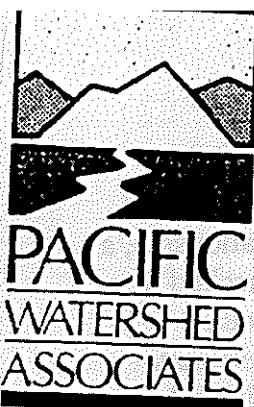


Appendix D

Road-related and non road-related erosion and sediment delivery to Clapp Gulch, Railroad Gulch, South Fork Elk River and lower mainstem Elk River (interfluves), Pacific Watershed Associates, December 2001



Date: 12/10/01

RWQCB
REGION 1

JUN 25 2002

To: Matt O'Connor, OEI

HAL CWS FJB
 NPO DMH

From: Eileen Weppner, PWA

Subject: Road-related and non road-related erosion and sediment delivery to Clapp Gulch, Railroad Gulch, South Fork Elk River and lower mainstem Elk River (interfluves)

Enclosed are ten (10) tables containing information on past road-related and non road-related erosion and sediment delivery for Clapp Gulch, Railroad Gulch, Tom Gulch, South Fork Elk River and lower mainstem Elk River. The data sets used to compile the tables include both the field inventory data and data generated from the air photo analysis of non road-related and road-related sites with past erosion and sediment delivery.

The *field inventory* included 100% inventory of the road system for all road-related sites (i.e. stream crossings, ditch relief culverts, landslides, etc.) of past erosion and sediment delivery.

The *air photo analysis* involved identification of non road-related and road-related shallow landslides (and estimated sediment delivery volumes) using historic aerial photography from the following years: 1954, 1966, 1974, 1987, 1997.

Data collected for air photo identified landslides followed Pacific Lumber Company Watershed Analysis procedures outlined in the Mass Wasting Module. Note that the data differs from the data used to create previous tables. The enclosed tables are based on the final data sets whereas the previous tables were based on draft data. Disregard any tables sent previous to 12/10/01.

All road-related and non road-related landslides identified in the air photo analysis were cross checked with landslides identified in the field inventory to ensure no duplication. Data for duplicated landslides (sites identified in both the road inventory and the air photo analysis) was deleted from the air photo database and kept in the field inventory.

The following assumptions were used in deriving sediment delivery volumes for landslides identified by air photo analysis in Clapp Gulch, Railroad Gulch, Tom Gulch, South Fork Elk River and lower mainstem Elk River:

) Depth was determined for all air photo identified landslides by using the depth regression equation employed in the Freshwater Creek sediment source inventory. PWA did not determine a unique depth equation for South Fork Elk River. It is our understanding that Hart Crowser will be responsible for field checking a sample of air photo identified landslides and determining the appropriate depth relationship. In the mean time, because of similar geologies, this relationship should provide a good depth estimate.

For Freshwater Creek (and the attached tables), the depth/area regression equation

was:

$$\text{Depth (ft)} = (0.000237 * \text{Area (ft}^2\text{)}) + 1.426$$

In the past, PWA has determined depth for air photo identified landslides by calculating a regression equation based on the relationship between area (ft^2) and depth (ft). To determine this relationship, a sample set of the landslides identified on the youngest photos (i.e. 1997 or 2000) is field checked for true length, width and depth measurements. The field data is then plotted to determine a linear relationship between area (ft^2) and depth (ft). The resulting regression equation is used to estimate depth for all landslides identified in the air photo analysis. The derived depth was then modified by several physical restrictions. Field observations provided the basis for the following "restrictions."

- i) The maximum allowable depth for landslides in which length is greater than or equal to width based on field observations (these are the classic landslides): 10 feet
 - ii) The minimum depth on all landslides based on field observations: 2 feet
 - iii) The maximum depth based on field observations for landslides in which the width is substantially greater than length (these are the wide, shallow landslides): 4 feet
- 2) Skid related landslides are not considered road-related landslides. Skids are considered part of tractor yarding activities and therefore are not road related. They are classified as non road-related landslides.
- 3) Railroad related landslides are considered to be road-related landslides. Railroad building practices are assumed to be similar and at least on the same scale as road building.

We have not described or interpreted the data in the attached tables. We will leave that to you, unless you need some assistance or clarification. If you have any questions, please call.

Preliminary estimate of past non road-related debris landslide and debris torrent erosion and sediment delivery (to stream channels), by decade, Clapp Gulch, Elk River watershed, Humboldt County, California

Decade	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1954	4	7,203	25	2,383
1966	0	0	0	0
1974	1	39	65	25
1987	4	548	15	71
1997	41	11,183	20	2,331
2000	1	202	0	0
Totals	51	19,175	20	4,810

Preliminary estimate of past non road-related debris landslide and debris torrent erosion and sediment delivery (to stream channels), by decade, Railroad Gulch, Elk River watershed, Humboldt County, California

Decade	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1954	5	25,553	20	6,040
1966	3	19,660	70	12,662
1974	2	161	40	62
1987	7	5,500	15	1,192
1997	40	20,502	20	4,606
2000	3	1,194	20	205
Totals	60	72,570	25	24,767

Preliminary estimate of past non road-related debris landslide and debris torrent erosion and sediment delivery (to stream channels), by decade, Tom Gulch, Elk River watershed, Humboldt County, California

Decade	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1954	8	16,769	45	9,712

Preliminary estimate of past non road-related debris landslide and debris torrent erosion and sediment delivery (to stream channels), by decade, Tom Gulch, Elk River watershed, Humboldt County, California

Decade	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1966	7	3,820	50	2,289
1974	10	8,198	30	4,310
1987	8	2,313	20	382
1997	17	58,051	25	3,378
2000	1	100	15	13
Totals	51	89,251	30	20,084

Preliminary estimate of past non road-related debris landslide and debris torrent erosion and sediment delivery (to stream channels), by decade, South Fork Elk River, Elk River watershed, Humboldt County, California

Decade	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1954	33	84,899	40	38,057
1966	63	36,323	35	16,496
1974	74	34,141	35	12,604
1987	25	5,442	30	2,058
1997	53	49,458	30	32,934
2000	11	9,254	30	3,297
Totals	259	219,517	35	105,446

Preliminary estimate of past non road-related debris landslide and debris torrent erosion and sediment delivery (to stream channels), by decade, Mainstem Elk and associated interfluves, Elk River watershed, Humboldt County, California

Decade	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1954	0	0	0	0
1966	0	0	0	0
1974	1	134	65	84
1987	0	0	0	0
1997	6	812	25	165
2000	0	0	0	0
Totals	7	946	30	249

Preliminary estimate of past road-related erosion and sediment delivery (to stream channels), by decade and erosion process, Clapp Gulch, Elk River watershed, Humboldt County, California

Decade	Erosion Process	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1950	Stream crossing washout	0	0	0	0
	Gullies (fillslope/ hillslope/road)	0	0	0	0
	Stream bank erosion	0	0	0	0
	Cutbank Failure	0	0	0	0
	Road-related debris slides	0	0	0	0
	Torrent scour	0	0	0	0
	Sub-totals	0	0	0	0
	Stream crossing washout	0	0	0	0
	Gullies (fillslope/ hillslope/road)	0	0	0	0
	Stream bank erosion	0	0	0	0
1960	Cutbank Failure	0	0	0	0
	Road-related debris slides	0	0	0	0
	Torrent scour	0	0	0	0
	Sub-totals	0	0	0	0
	Stream crossing washout	1	75	100	75
	Gullies (fillslope/ hillslope/road)	0	0	0	0
	Stream bank erosion	0	0	0	0
	Cutbank Failure	0	0	0	0
	Road-related debris slides	2	109	15	9
	Torrent scour	0	0	0	0
1970	Sub-totals	3	184	40	84
	Stream crossing washout	7	181	100	181
1980	Gullies (fillslope/ hillslope/road)	4	104	50	60
	Stream bank erosion	1	17	100	17

Preliminary estimate of past road-related erosion and sediment delivery (to stream channels), by decade and erosion process, Clapp Gulch, Elk River watershed, Humboldt County, California

Decade	Erosion Process	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1990	Cutbank Failure	1	5	100	5
	Road-related debris slides	4	1,105	15	97
	Torrent scour	0	0	0	0
	Sub-totals	17	1,412	65	360
1990	Stream crossing washout	16	422	100	422
	Gullies (fillslope/ hillslope/road)	12	1,220	100	1,220
	Stream bank erosion	2	335	100	335
	Cutbank Failure	5	456	25	91
	Road-related debris slides	47	19,976	35	7,192
	Torrent scour	1	777	50	396
	Sub-totals	83	23,186	55	9,656
Total road-related erosion and sediment yield¹		103	24,782	55	10,100

Preliminary estimate of past road-related erosion and sediment delivery (to stream channels), by decade and erosion process, Railroad Gulch, Elk River watershed, Humboldt County, California

Decade	Erosion Process	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1950	Stream crossing washout	0	0	0	0
	Gullies (fillslope/ hillslope/road)	0	0	0	0
	Stream bank erosion	0	0	0	0
	Cutbank Failure	0	0	0	0
	Road-related debris slides	0	0	0	0
	Torrent scour	0	0	0	0
	Sub-totals	0	0	0	0
	Stream crossing washout	0	0	0	0
	Gullies (fillslope/ hillslope/road)	0	0	0	0
	Stream bank erosion	0	0	0	0
1960	Cutbank Failure	0	0	0	0
	Road-related debris slides	0	0	0	0
	Torrent scour	0	0	0	0
	Sub-totals	0	0	0	0
	Stream crossing washout	3	30	100	30
	Gullies (fillslope/ hillslope/road)	1	19	25	5
	Stream bank erosion	0	0	0	0
	Cutbank Failure	1	164	0	0
	Road-related debris slides	4	979	20	254
	Torrent scour	0	0	0	0
1970	Sub-totals	9	1,192	45	289
	Stream crossing washout	12	412	100	412
	Gullies (fillslope/ hillslope/road)	5	130	100	130
1980	Stream bank erosion	2	59	100	59

Preliminary estimate of past road-related erosion and sediment delivery (to stream channels), by decade and erosion process, Railroad Gulch, Elk River watershed, Humboldt County, California

Decade	Erosion Process	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1990	Cutbank Failure	2	154	10	2
	Road-related debris slides	2	1,460	5	36
	Torrent scour	0	0	0	0
	Sub-totals	23	2,215	85	639
	Stream crossing washout	5	180	100	180
	Gullies (fillslope/ hillslope/road)	5	509	70	270
	Stream bank erosion	0	0	0	0
	Cutbank Failure	1	400	5	24
1990	Road-related debris slides	25	25,911	25	7,876
	Torrent scour	5	2,663	40	990
	Sub-totals	41	29,663	40	9,340
	Total road-related erosion and sediment yield¹	73	33,070	55	10,268

Preliminary estimate of past road-related erosion and sediment delivery (to stream channels), by decade and erosion process, Tom Gulch, Elk River watershed, Humboldt County, California

Decade	Erosion Process	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1950	Stream crossing washout	0	0	0	0
	Gullies (fillslope/ hillslope/road)	0	0	0	0
	Stream bank erosion	0	0	0	0
	Cutbank Failure	0	0	0	0
	Road-related debris slides	0	0	0	0
	Torrent scour	0	0	0	0
	Sub-totals	0	0	0	0
	Stream crossing washout	0	0	0	0
	Gullies (fillslope/ hillslope/road)	0	0	0	0
	Stream bank erosion	0	0	0	0
1960	Cutbank Failure	0	0	0	0
	Road-related debris slides	0	0	0	0
	Torrent scour	0	0	0	0
	Sub-totals	0	0	0	0
	Stream crossing washout	7	372	100	372
	Gullies (fillslope/ hillslope/road)	1	2	100	2
	Stream bank erosion	2	85	100	85
	Cutbank Failure	0	0	0	0
	Road-related debris slides	2	177	85	164
	Torrent scour	0	0	0	0
1970	Sub-totals	12	636	95	623
	Stream crossing washout	84	4,954	100	4,954
1980	Gullies (fillslope/ hillslope/road)	23	752	95	741
	Stream bank erosion	34	1,018	100	1,018

Preliminary estimate of past road-related erosion and sediment delivery (to stream channels), by decade and erosion process, Tom Gulch, Elk River watershed, Humboldt County, California

Decade	Erosion Process	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1990	Cutbank Failure	1	15	100	15
	Road-related debris slides	15	3,458	50	841
	Torrent scour	1	7	100	7
	Sub-totals	158	10,204	75	7,576
1990	Stream crossing washout	6	350	100	350
	Gullies (fillslope/ hillslope/road)	3	188	95	137
	Stream bank erosion	3	66	100	66
	Cutbank Failure	1	45	0	0
	Road-related debris slides	27	8,310	45	2,444
	Torrent scour	2	794	65	510
	Sub-totals	42	9,753	60	3,507
	Total road-related erosion and sediment yield ¹	212	20,593	75	11,706

Preliminary estimate of past road-related erosion and sediment delivery (to stream channels), by decade and erosion process, SF Elk River, Elk River watershed, Humboldt County, California

Decade	Erosion Process	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1950	Stream crossing washout	0	0	0	0
	Gullies (fillslope/ hillslope/road)	1	3	100	3
	Stream bank erosion	0	0	0	0
	Cutbank Failure	1	778	5	39
	Road-related debris slides	6	1,577	45	845
	Torrent scour	0	0	0	0
	Sub-totals	8	2,358	50	887
	Stream crossing washout	7	267	100	267
	Gullies (fillslope/ hillslope/road)	3	94	100	94
	Stream bank erosion	1	17	100	17
1960	Cutbank Failure	0	0	0	0
	Road-related debris slides	11	2,039	30	618
	Torrent scour	0	0	0	0
	Sub-totals	22	2,417	65	996
	Stream crossing washout	17	1,360	100	1,360
	Gullies (fillslope/ hillslope/road)	4	213	100	213
	Stream bank erosion	10	504	100	504
	Cutbank Failure	3	2,313	40	28
	Road-related debris slides	17	8,337	30	1,508
	Torrent scour	0	0	0	0
1970	Sub-totals	51	12,727	70	3,613
	Stream crossing washout	78	2,851	100	2,851
	Gullies (fillslope/ hillslope/road)	44	2,637	95	2,583
	Stream bank erosion	22	674	100	674
1980					

Preliminary estimate of past road-related erosion and sediment delivery (to stream channels), by decade and erosion process, SF Elk River, Elk River watershed, Humboldt County, California

Decade	Erosion Process	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1990	Cutbank Failure	0	0	0	0
	Road-related debris slides	4	1,753	50	1,018
	Torrent scour	1	8	100	8
	Sub-totals	149	7,923	95	7,134
	Stream crossing washout	25	601	100	601
	Gullies (fillslope/ hillslope/road)	14	547	95	505
	Stream bank erosion	7	940	100	940
1990	Cutbank Failure	2	199	5	12
	Road-related debris slides	14	7,699	35	5,092
	Torrent scour	0	0	0	0
	Sub-totals	62	9,986	80	7,150
	Total road-related erosion and sediment yield¹	292	35,411	85	19,780

Preliminary estimate of past road-related erosion and sediment delivery (to stream channels), by decade and erosion process, Mainstem Elk River and associated interfluves, Elk River watershed, Humboldt County, California

Decade	Erosion Process	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1950	Stream crossing washout	0	0	0	0
	Gullies (fillslope/ hillslope/road)	0	0	0	0
	Stream bank erosion	0	0	0	0
	Cutbank Failure	0	0	0	0
	Road-related debris slides	0	0	0	0
	Torrent scour	0	0	0	0
	Sub-totals	0	0	0	0
	Stream crossing washout	0	0	0	0
	Gullies (fillslope/ hillslope/road)	0	0	0	0
	Stream bank erosion	0	0	0	0
1960	Cutbank Failure	0	0	0	0
	Road-related debris slides	0	0	0	0
	Torrent scour	0	0	0	0
	Sub-totals	0	0	0	0
	Stream crossing washout	0	0	0	0
	Gullies (fillslope/ hillslope/road)	0	0	0	0
	Stream bank erosion	0	0	0	0
	Cutbank Failure	0	0	0	0
	Road-related debris slides	0	0	0	0
	Torrent scour	0	0	0	0
1970	Sub-totals	0	0	0	0
	Stream crossing washout	8	182	100	182
1980	Gullies (fillslope/ hillslope/road)	3	57	100	57

Preliminary estimate of past road-related erosion and sediment delivery (to stream channels), by decade and erosion process, Mainstem Elk River and associated interfluves, Elk River watershed, Humboldt County, California

Decade	Erosion Process	Number	Past erosion (yds ³)	Average past delivery (%)	Past sediment delivery (yds ³)
1980	Stream bank erosion	1	11	100	11
	Cutbank Failure	0	0	0	0
	Road-related debris slides	2	1,780	50	847
	Torrent scour	0	0	0	0
	Sub-totals	14	2,030	90	1,097
1990	Stream crossing washout	1	18	100	18
	Gullies (fillslope/ hillslope/road)	3	102	100	102
	Stream bank erosion	0	0	0	0
	Cutbank Failure	0	0	0	0
	Road-related debris slides	13	5,693	35	2,345
	Torrent scour	0	0	0	0
	Sub-totals	17	5,813	50	2,465
Total road-related erosion and sediment yield ¹		31	7,843	70	3,562